Range & Stopping Power in Nucleonica

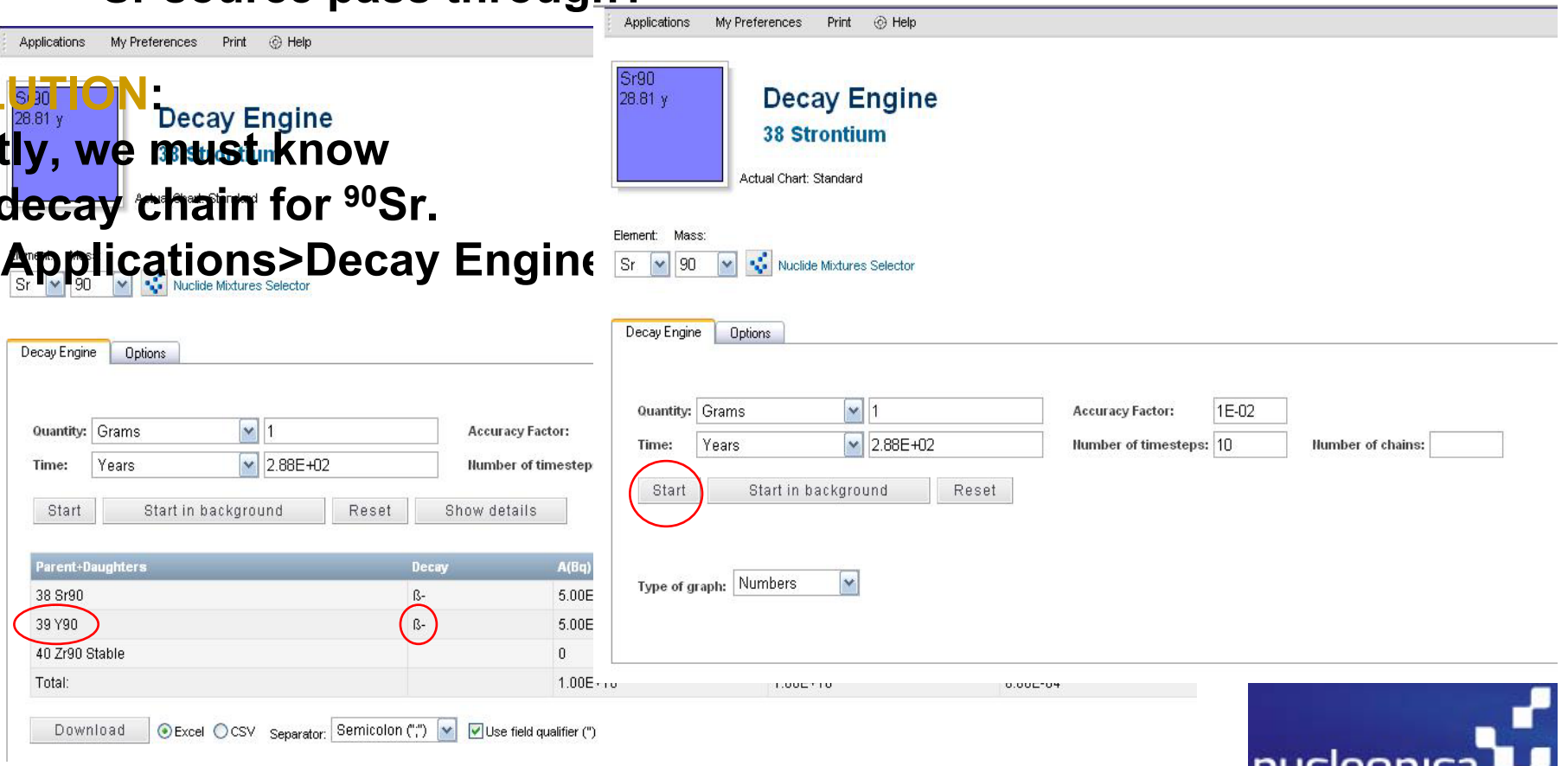
CASE STUDY

Q1: What must be the minimum thickness of a shield made of (a) Plexiglas and (b) aluminum in order that no beta rays from a ^{90}Sr source pass through?

SOLUTION:

Firstly, we must know the decay chain for ^{90}Sr.

Go, Applications>Decay Engine



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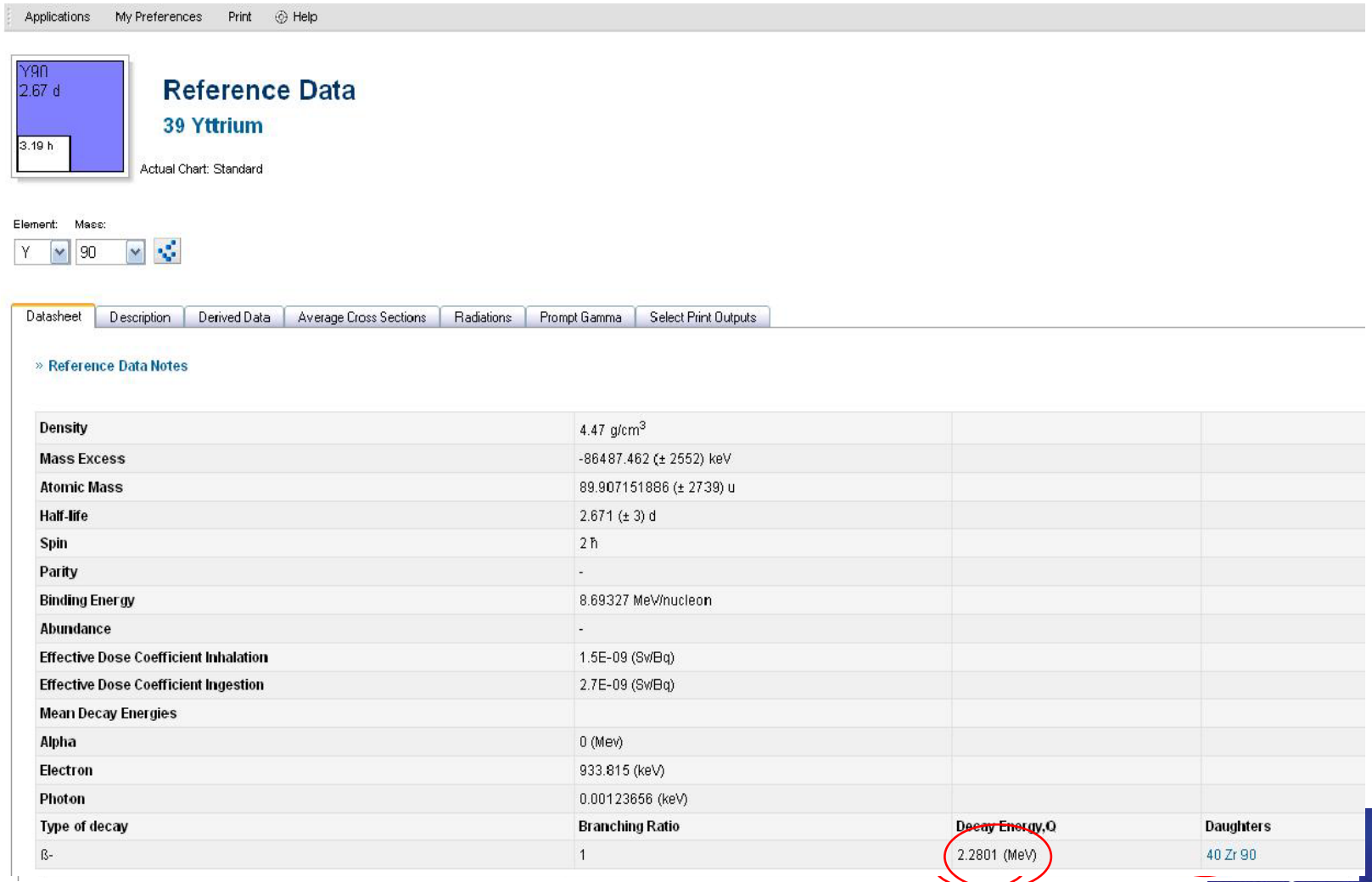
What is the energies of beta rays from ^{90}Sr and ^{90}Y?
Go Applications>Nuclide Datasheet



Density	4.47 g/cm^3		
Mass Excess	-86487.462 (± 2552) keV		
Atomic Mass	89.907151886 (± 2739) u		
Half-life	2.671 (± 3) d		
Spin	2 ħ		
Parity	-		
Binding Energy	8.69327 MeV/nucleon		
Abundance	-		
Effective Dose Coefficient Inhalation	1.5E-09 (Sv/Bq)		
Effective Dose Coefficient Ingestion	2.7E-09 (Sv/Bq)		
Mean Decay Energies			
Alpha	0 (Mev)		
Electron	933.815 (keV)		
Photon	0.00123656 (keV)		
Type of decay	**Branching Ratio**	**Decay Energy,Q**	**Daughters**
ß-	1	2.2801 (MeV)	40 Zr 90

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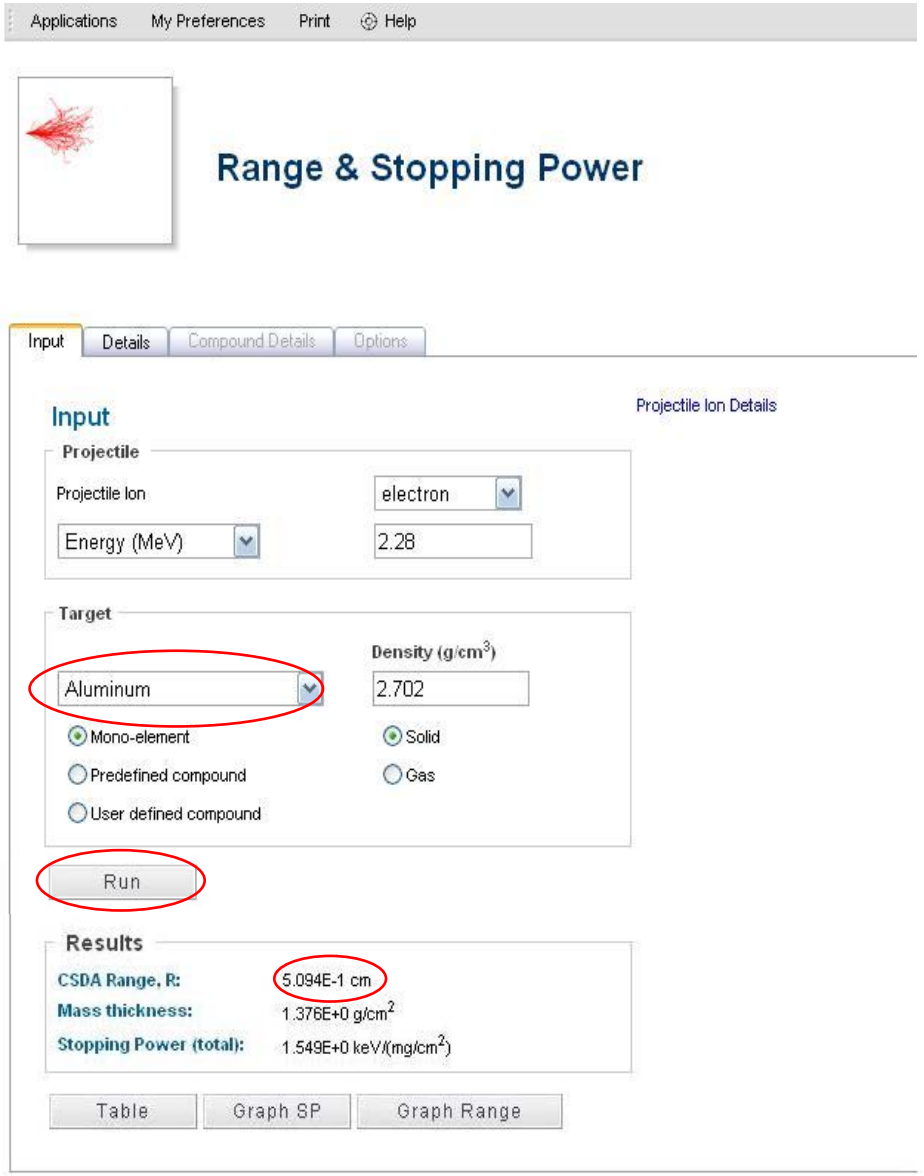

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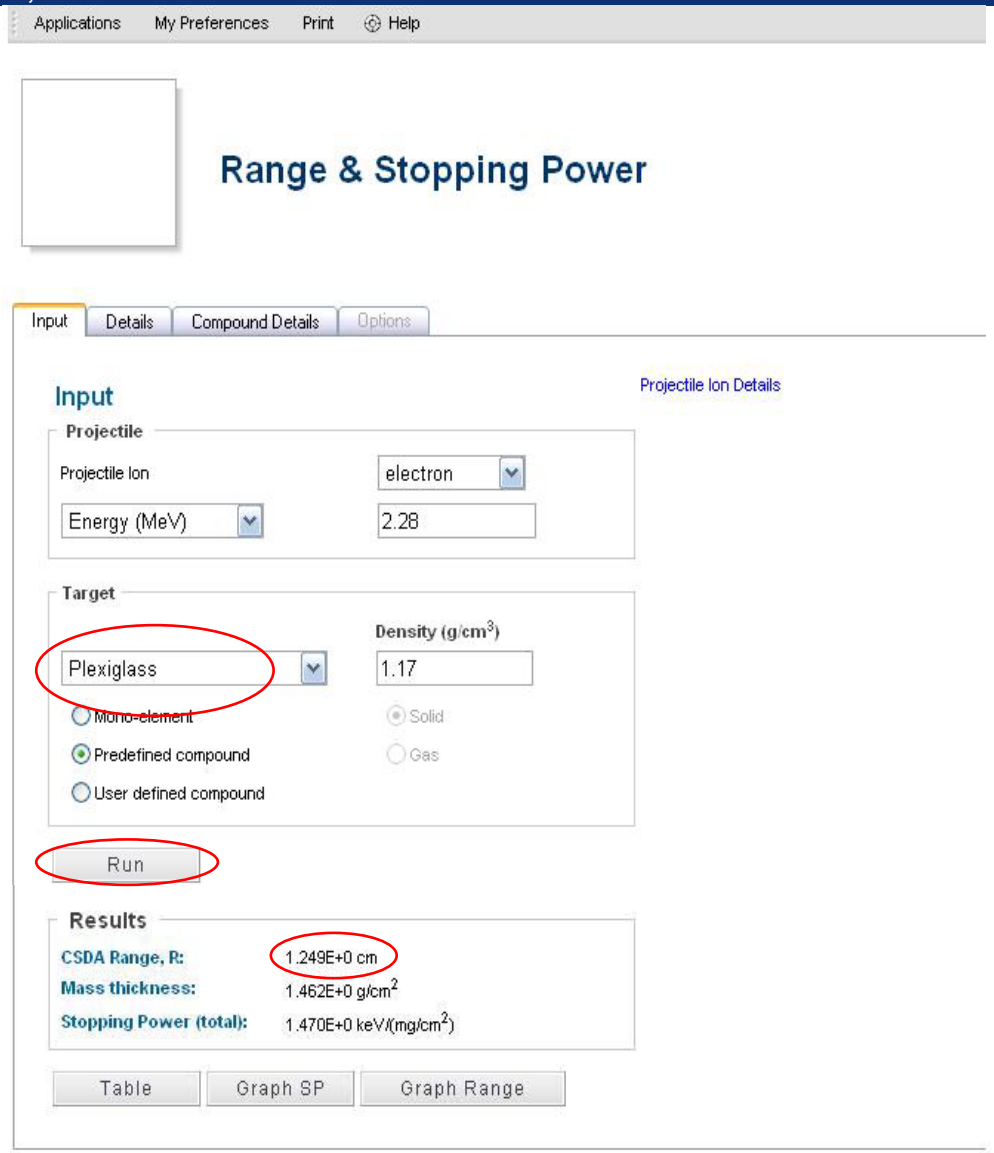

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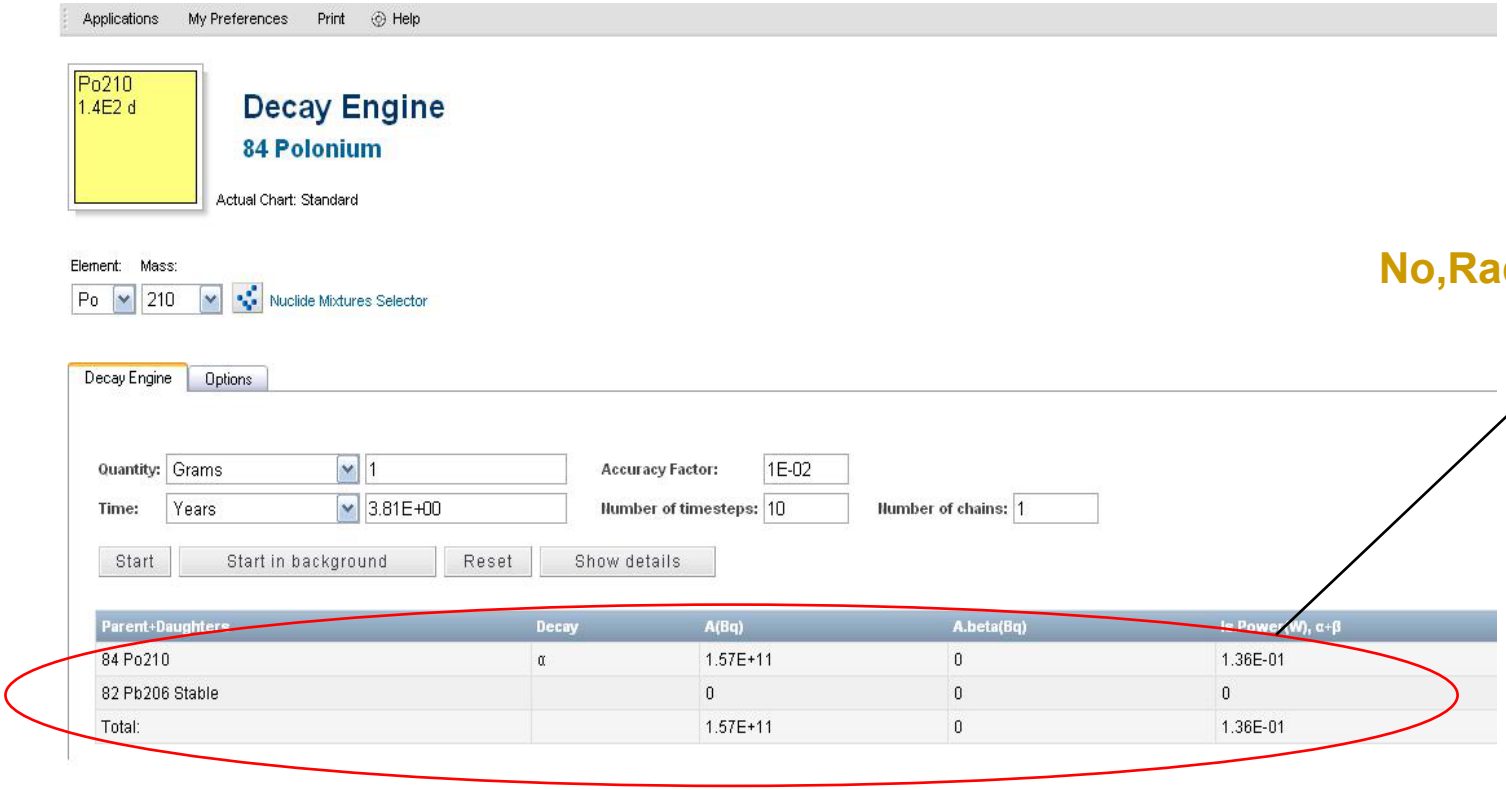
Q2:What thickness of aluminum foil is required to stop the alpha particles from ^{210}Po?

Hint: Check the decay chain of 210Po, then find the maximum energy of the alpha particles emited in the chain.

SOLUTION:



No,Radioactive daughter

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Applications>Nuclide Datasheet

Applications My Preferences Print Help

Po210
1.4E2 d

Reference Data

84 Polonium

Actual Chart: Standard

Element: Po Mass: 210

Datasheet | Description | Derived Data | Average Cross Sections | Radiations | Prompt Gamma | Select Print Outputs

» Reference Data Notes

Density	9.20 g/cm^3		
Mass Excess	-15953.071 (± 1242) keV		
Atomic Mass	209.982873673 (± 1333) u		
Half-life	138.388 (± 4) d		
Spin	0 ħ		
Parity	+		
Binding Energy	7.83435 MeV/nucleon		
Abundance	-		
Effective Dose Coefficient Inhalation	4.3E-06 (Sv/Bq)		
Effective Dose Coefficient Ingestion	1.2E-06 (Sv/Bq)		
Mean Decay Energies			
Alpha	5.40752 (Mev)		
Electron	9.32726E-05 (keV)		
Photon	0.00972462 (keV)		
Type of decay	**Branching Ratio**	**Decay Energy,Q**	**Daughters**
α	1	5.40745 (MeV)	82 Pb 206

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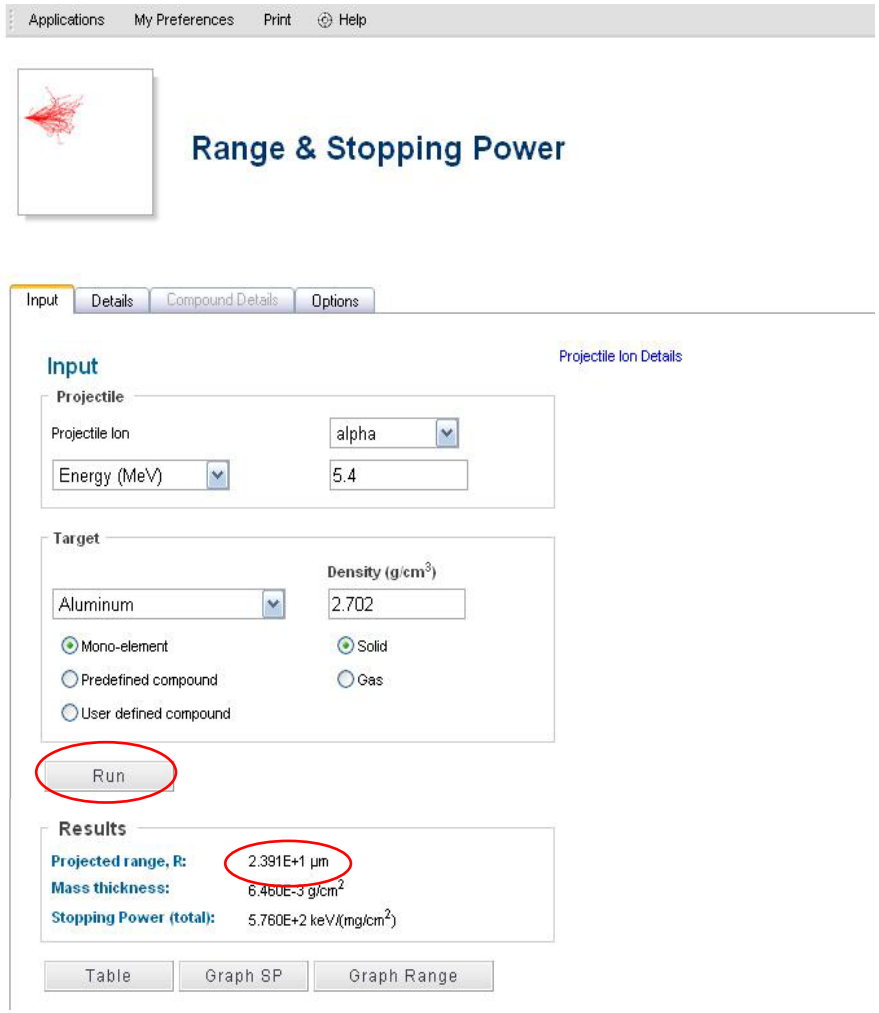

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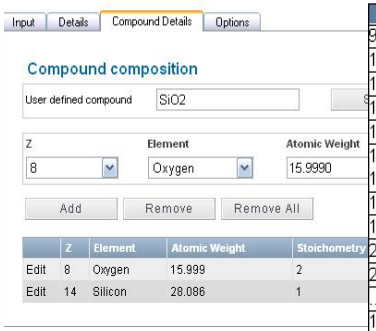
Q3: What ar … n depht in SiO_2 sam…

SOLUTION




```
============================================================
           Calculation using SRIM-2006
           SRIM version --->
           Calc. date   ---> Oktober 02, 2008
============================================================

Disk File Name = range_out2.txt

Ion = Carbon       [6] , Mass = 12 amu

Density =  1.0000E+00 g/cm3 = 3.0068E+22 atoms/cm3
======= Target  Composition ========
   Atom   Atom   Atomic    Mass
   Name   Numb   Percent   Percent
   ----   ----   -------   -------
     O      8    066.67    053.26
    Si     14    033.33    046.74
==================================
Bragg Correction = 0.00%
Stopping Units =  keV/(mg/cm2)
See bottom of Table for other Stopping units

Ion = Carbon       [6] , Mass = 12 amu
```

Ion Energy	dE/dx Elec.	dE/dx Nuclear	Projected Range	Longitudinal Straggling	Lateral Straggling
999.999 eV	1.153E+02	5.618E+02	106 A	73 A	53 A
1.10 keV	1.209E+02	5.701E+02	114 A	78 A	57 A
1.20 keV	1.263E+02	5.772E+02	122 A	83 A	60 A
1.30 keV	1.314E+02	5.833E+02	130 A	87 A	63 A
1.40 keV	1.364E+02	5.885E+02	137 A	92 A	67 A
1.50 keV	1.412E+02	5.930E+02	145 A	96 A	70 A
1.60 keV	1.458E+02	5.970E+02	153 A	101 A	73 A
1.70 keV	1.503E+02	6.004E+02	160 A	105 A	76 A
1.80 keV	1.546E+02	6.033E+02	168 A	109 A	79 A
2.00 keV	1.630E+02	6.080E+02	183 A	118 A	85 A
2.25 keV	1.729E+02	6.122E+02	201 A	128 A	93 A
…	…	…	…	…	
150.00 MeV	1.136E+03	5.492E-01	771.98 um	29.13 um	8.35 um
160.00 MeV	1.076E+03	5.183E-01	862.38 um	31.87 um	9.24 um
170.00 MeV	1.023E+03	4.908E-01	957.64 um	34.67 um	10.17 um
180.00 MeV	9.750E+02	4.663E-01	1.06 mm	37.51 um	11.15 um
200.00 MeV	8.918E+02	4.241E-01	1.27 mm	48.37 um	13.24 um
225.00 MeV	8.070E+02	3.814E-01	1.57 mm	64.02 um	16.11 um
250.00 MeV	7.384E+02	3.469E-01	1.89 mm	78.89 um	19.26 um
…	…	…	…	…	
800.00 MeV	2.934E+02	1.207E-01	15.21 mm	660.40 um	145.03 um
900.00 MeV	2.679E+02	1.084E-01	18.78 mm	832.40 um	177.97 um
1.00 GeV	2.472E+02	9.848E-02	22.67 mm	998.94 um	213.62 um

```
------------------------------------------------------------
Multiply Stopping by        for Stopping Units
-------------------        ------------------
 9.9997E-03                eV/Angstrom
 9.9997E-02                keV/micron
 9.9997E-02                MeV/mm
 1.0000E-03                keV/(ug/cm2)
 1.0000E-03                MeV/(mg/cm2)
 1.0000E+00                keV/(mg/cm2)
 3.3257E-02                 eV/(1E15 atoms/cm2)
 4.9275E-04                L.S.S. reduced units
============================================================
(C) 1984,1989,1992,1998,2006 by J.P. Biersack and J.F. Ziegler
```

Not Important

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Thanks!

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